APPENDIX B

The proposed Martinsdale Wind Farm lies in the upper Musselshell watershed, which was used to define the visibility analysis area.

In this part of the watershed, the Musselshell River flows toward the east, and the basin is defined by the crest of the Little Belt Mountains on the north and the Caste Mountains and Crazy Mountains to the south and south west. The watershed is 35 miles wide north to south at the site of the project area, and almost 100 miles long east to west. The project area is located just north of the Musselshell River on a series of low ridges and hills, 17 miles from the western edge of the watershed.

Catchment Area Development

Figure 4.3-1 in the Environmental Impact Statement (EIS) for the Martinsdale Wind Farm LLC, Horizon Wind Energy portrays a catchment area for the project. The catchment area is the area in which at least one wind turbine tower can be seen. The catchment area was created as described below.

A digital elevation model (DEM) was created for the Upper Musselshell watershed using the 30 meter DEMs available from the Montana Natural Resource Information System (NRIS) website. This elevation surface was clipped to the watershed boundaries and the 30 meter DEM was generalized to a 90 meter DEM to increase the speed of conducting the visibility analysis.

The locations of the 126 possible wind turbines were added to the model, and given a height of 250 feet (76.2 meters) which is the total height of the turbine nacelles and their supporting towers. The turbine blades are higher, but are much thinner than the support towers and are thus much less visible from longer distances.

The Spatial Analyst program within ArcGIS was used to ask the question: “Are any of the 250 foot high towers visible from a 5 ½ foot high observer standing in the center of each 90 meter square cell in the upper watershed?” The result is shown on Figure 4.3-1.

The visibility analysis takes into account the curvature of the Earth’s surface across the DEM, and assumes that no physical obstacles (clouds, trees or buildings) aside from physical geographic features lie between the observer’s position and the towers. The analysis generates a basic “line-of-sight” result, meaning that at longer distances (10 miles or more) the towers may not be visible by the naked eye, but could be seen by an observer using binoculars on a clear day. The blinking red lights of the towers will be seen at night at longer distances than the towers themselves could be seen by day.

Photographic Simulations

Technical information on the generation of photographic simulations is provided here. Computer Aided Design (CAD), Geographic Information System (GIS), and 3-dimensional (3-D) modeling and design software, Global Positioning Systems (GPS) equipment, a digital single lens reflex (SLR) camera, and general turbine designs were used to prepare the photograph simulations.

<u>Photographs</u>

On June 16th and 17th, 2008, the photographs used for the simulations were taken. Photograph viewpoints were determined in the field based on the likely visibility of the proposed turbines. GIS readings were recorded from each viewpoint at which a photograph was taken. Figure 3.4.2 provides the locations of the viewpoints from which photographs were taken.

GPS data were obtained using the Trimble Explorer XT GPS unit, which has an accuracy of plus or minus 1 meter. GPS coordinates of the photograph points were downloaded into ArcGIS 9.2 and checked by comparing them to locations on the 2005 NAIP (National Agricultural Imagery Program) aerial photos.

On-site photographs were acquired using a Canon30D digital SLR using a Tamron 35-300mm vibration control (VC) zoom lens. Photographs were all hand held, starting with a 35mm 90 degree panorama of the project area, and followed by a 70 to 125mm 90 degree panorama of the area.

The 70 mm photographs were used for the computer renderings because it was assumed to approximate the human field of vision (FOV) the for the most part.

<u>Computer Rendering Process</u>

Model Construction: The 3-dimentional (3D) model was developed in three steps.

- Step 1: Digitized the topography into Autodesks Earthworks. Then used Earthworks to create a 3D surface grid to which the exact camera locations were established using the field GPS readings.

- Step 2: Built a detailed model of a typical turbine in Autodesk 3D Studio using the Suzlon turbine company drawings.

- Step 3: Combined the 3D turbine models and topographic 3D grid by inputting GPS data for all turbine centerpoint locations. The turbine 3D models were then copied and placed onto the centerpoints. The sun location and omi lights were input into the 3D model to approximate time of day each photo was taken. This allows the accurate rendering of shadows to match photograph backgrounds (see below).

Rendering: Using the 3D model and camera locations, the photographs from the field trip were then projected behind the model. The camera locations were then adjusted until the 3D grid matched and aligned with the 3D model camera FOV. Materials were added to the turbines and the 3D grid was turned into a mask to block any turbines hidden by topography geometry. Final renderings were run at high resolution using ray tracing and shadow casting parameters.

Completed Computer Renderings

Five figures from three difference viewpoints were computer rendered for this project. Provided below is a description of each viewpoint and how it was generated.

Viewpoint #5

The stitching command in Picture Publisher was used to "stitch" four photographs together for the photograph simulation from viewpoint location #5. Anchor points located on the photographs were used by Picture Publisher to combine two photographs into a seamless image. Stitching is not a panoramic picture; a panoramic image uses a special lens that distorts the image. Stitching the images retains the accuracy of each image and minimizes the amount of lens distortion.

Four photographs were stitched together to provide approximately twice the FOV that a single 70 mm photograph would show. The center portion of each of the four images was used because of optical distortion on the edges of the photographs.

Viewpoint #3a

This viewpoint was taken from Highway 12 looking east and a little north. Four-70 mm photographs were stitched together to form the image background.

Viewpoint #3b

This viewpoint was taken from Highway 12 looking east and a little south. Four-70 mm photographs were stitched together to form the image background.

Viewpoint #8a

This viewpoint was taken from a small rise at a fishing access exit off Highway 12 looking northwest. Four-70 mm photographs were stitched together to form the image background.

Viewpoint #8b

This viewpoint was taken from a small rise at a fishing access exit off Highway 12 looking north. Four-70 mm photographs were stitched together to form the image background.

Nighttime Photographs

Nighttime photographs of the Judith Gap Windfarm were taken on September 25, 2008 from approximately 7:46 to 8:24 p.m. The weather was cool, windy, and cloudy with a high overcast sky and no snow cover. The two nighttime photographs shown on the following page were taken at milepost 8 on State Highway 191 looking northeast which is located approximately one mile from the nearest wind turbine.

Photographs (not used for Rendering)

Photographs taken for potential use in the rendering step of this analysis are provided after the page showing two nighttime photographs.

Unaltered nighttime photograph showing the lighting on the Judith Gap wind turbines.

Enhanced nighttime photograph showing the lighting on the Judith Gap wind turbines.

Viewpoint #1: Looking east from Highway 12
35 mm lens

Viewpoint #1: Looking east from Highway 12
70mm lens

Viewpoint #1: Looking east from Highway 12
125 mm

Viewpoint #2: Looking east from Highway 12: Image 8278
50 mm Lens

Viewpoint #2: Looking east from Highway 12: Image 8286
70 mm Lens

Viewpoint #4: Looking north from Martinsdale Reservoir: Image 8336
50 mm Lens

Viewpoint #4: Looking north from Martinsdale Reservoir: Image 8336
70 mm Lens

Viewpoint #4: Looking north from Martinsdale Reservoir: Image 8336
125 mm Lens

Viewpoint #6: Looking southeast from Findon Lane: Image 8412
50 mm Lens

Viewpoint #6: Looking southeast from Findon Lane: Image 8425
70 mm Lens

Viewpoint #7: Looking east from Findon Lane: Image 8438
50 mm Lens

Viewpoint #7: Looking east from Findon Lane: Image 8447
70 mm Lens

Viewpoint #7: Looking east from Findon Lane: Image 8462
125 mm Lens

Viewpoint #10: Looking northeast from Highway 191: Image 8526
50 mm Lens

Viewpoint #10: Looking northeast from Highway 191: Image 8539
70 mm Lens

Viewpoint #10: Looking northeast from Highway 191: Image 8535
125 mm Lens

Viewpoint #14: Looking west from Haymaker Road: Image 8580
50 mm Lens

Viewpoint #14: Looking west from Haymaker Road: Image 8589
70 mm Lens

Viewpoint #15: Looking west from Haymaker Road: Image 8606
50 mm Lens

Viewpoint #15: Looking west from Haymaker Road: Image 8642
70 mm Lens

Viewpoint #16: Looking southwest from north of project area: Image 8644
50 mm Lens

Viewpoint #17: Looking east from Haymaker Road: Image 8662
50 mm Lens

Viewpoint #17: Looking east from Haymaker Road: Image 8663
70 mm Lens